AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently amended) A print head apparatus, comprising:

a substrate;

an ink expulsion mechanism provided on said substrate;

an ink well defined proximate said ink expulsion mechanism and a nozzle formed as an egress from said ink well in a member opposing said ink expulsion mechanism; and

a first pressure sensor that is formed ~~substantially at~~ on said substrate within said ink well and in a same plane as said ink expulsion mechanism, said first pressure sensor configured to detect pressure waves induced by a firing of said ink expulsion mechanism.

2. (Original) The apparatus of claim 1, wherein said sensor includes piezoelectric material.

3. (Canceled)

4. (Previously presented) The apparatus of claim 1, further comprising:

a barrier layer formed on said substrate;

a cover plate having a nozzle therein formed on said barrier layer and positioned such that said nozzle is aligned with said ink expulsion mechanism, said substrate, barrier and cover plate defining said ink well; and

wherein said first sensor is provided at said ink well in such a manner as to detect pressure waves propagating in ink in said ink well caused by a firing of said ink expulsion mechanism.

5. (Original) The apparatus of claim 1, wherein said first pressure sensor is an acoustic

wave piezoelectric transducer.

6. (Original) The apparatus of claim 1, wherein said first pressure sensor is an interdigitated pressure wave transducer.

7. (Currently amended) ~~The apparatus of claim 1, further comprising~~ A print head apparatus, comprising:

a substrate;

an ink expulsion mechanism provided on said substrate;

an ink well defined proximate said ink expulsion mechanism and a nozzle formed as an egress from said ink well;

a first pressure sensor that is formed substantially at said ink well and configured to detect pressure waves induced by a firing of said ink expulsion mechanism; and

a second pressure sensor, wherein said first pressure sensor is an acoustic wave piezoelectric transducer and said second pressure sensor is an interdigitated pressure wave transducer.

8. (Original) The apparatus of claim 1, wherein said ink expulsion mechanism is thermally actuated.

9. (Currently amended) ~~The apparatus of claim 6, further comprising~~ A print head apparatus, comprising:

a substrate;

an ink expulsion mechanism provided on said substrate;

an ink well defined proximate said ink expulsion mechanism and a nozzle formed as an egress from said ink well;

a first pressure sensor that is formed substantially at said ink well and configured to detect pressure waves induced by a firing of said ink expulsion mechanism, wherein said first pressure sensor is an interdigitated pressure wave transducer; and

a second pressure sensor that is an interdigitated pressure wave transducer and said first sensor and said second sensor are provided in a substantially orthogonal arrangement on said substrate.

10. (Currently amended) A print head apparatus, comprising:

a substrate;

an ink expulsion mechanism formed on said substrate;

a cover plate spaced from said ink expulsion mechanism and having a nozzle formed therein, said nozzle being aligned with said ink expulsion mechanism; and

a sensor mechanism formed on said substrate that is capable of detecting ~~signals~~ a pressure wave of a first non-zero magnitude indicative of when said nozzle is clogged.

11. (Currently amended) The apparatus of claim 10, wherein said sensor mechanism is capable of detecting ~~signals~~ a pressure wave of a second non-zero magnitude different from said first non-zero magnitude indicative of when said nozzle is unclogged.

12. (Currently amended) The apparatus of claim 10, wherein said sensor mechanism is capable of detecting ~~signals~~ pressure waves indicative of one or more of the group of conditions including dry-fire and no-fire conditions.

13. (Currently amended) The apparatus of claim 10, wherein said sensor mechanism is a pressure wave sensor.

14. (Currently amended) The apparatus of claim 13, wherein said sensor mechanism includes piezoelectric material.

15. (Currently amended) ~~The apparatus of claim 10~~ A print head apparatus, comprising:

a substrate;

an ink expulsion mechanism formed on said substrate;

a cover plate spaced from said ink expulsion mechanism and having a nozzle formed therein, said nozzle being aligned with said ink expulsion mechanism; and

a sensor mechanism formed on said substrate that is capable of detecting signals indicative of when said nozzle is clogged, wherein said sensor mechanism includes one or more of the group of sensors including a[[n]] piezoelectric acoustic wave transducer and an interdigitated pressure wave transducer.

16. (Currently amended) The apparatus of claim 10, wherein said sensor mechanism includes ~~further comprising~~ logic ~~coupled to said sensor mechanism~~ that is capable of determining a magnitude and timing of a pressure wave generated by a firing of said ink expulsion mechanism.

17. (Currently amended) A method of monitoring performance of a print head, comprising the steps of:

attempting expulsion of a volume of ink through a nozzle of a print head;

detecting a signal representative of a firing condition, the signal generated in response to the attempted expulsion; and

differentiating from the signal between a clogged nozzle firing condition, an unclogged nozzle firing condition, and a no-fire condition

~~detecting within said print head a firing quality related characteristic of a resultant pressure wave generated by said attempt to expel said volume of ink through said nozzle~~.

18. (Canceled)

19. (Previously presented) The method of claim 17, wherein said detecting step includes the step of detecting the presence or absence of a resultant pressure wave.

20. (Currently amended) The method of claim [[17]]19, wherein said detecting step

includes the step of detecting a magnitude and timing of said pressure wave.

21. (Currently amended) ~~The method of claim 20,~~ A method of monitoring performance of a print head, comprising the steps of:

attempting expulsion of a volume of ink through a nozzle of a print head; and

detecting within said print head a firing quality related characteristic of a resultant pressure wave generated by said attempt to expel said volume of ink through said nozzle, wherein said detecting step includes the step of detecting a magnitude and timing of said pressure wave, and wherein said detecting step further comprises the steps of establishing a first magnitude related to an expulsion of said volume of ink and detecting a second magnitude in the range of 15% to 25% less than said first magnitude.

22. (Currently amended) ~~The method of claim 20,~~ A method of monitoring performance of a print head, comprising the steps of:

attempting expulsion of a volume of ink through a nozzle of a print head; and

detecting within said print head a firing quality related characteristic of a resultant pressure wave generated by said attempt to expel said volume of ink through said nozzle, wherein said detecting step includes the step of detecting a magnitude and timing of said pressure wave, and wherein said detecting step further comprises the steps of establishing a first timing of said pressure wave related to an expulsion of said volume of ink and detecting a second timing in the range of 15% to 20% earlier than said first timing.

23. (Original) A printhead for an inkjet printing apparatus comprising:

a substrate;

at least one ink ejector disposed on said substrate;

an interdigitated pressure wave transducer disposed on said substrate and having a directional detection characteristic whereby a pressure wave traveling in a predetermined direction from said at least one ink ejector is preferentially detected.

24. (Original) A printhead in accordance with claim 23 further comprising a second interdigitated pressure wave transducer disposed on said substrate and having a directional detection characteristic oriented such that a pressure wave traveling in a second direction different than said predetermined direction is preferentially detected.

25. (Original) A printhead in accordance with claim 24 wherein said second direction is orthogonal to said predetermined direction.

26. (Original) A method of detecting a misfiring nozzle in an inkjet printhead comprising the steps of:

establishing a first magnitude of a pressure wave corresponding to an ejection of a predetermined volume of ink from a nozzle; and

detecting a second magnitude of a pressure wave in the range of 15% to 25% less than said first magnitude whereby a misfiring nozzle may be detected.

27. (Original) A method of detecting a misfiring nozzle in an inkjet printhead comprising the steps of:

establishing a first timing of an arrival of a pressure wave from an ejection of a predetermined volume of ink from a nozzle; and

detecting a second timing of an arrival of a pressure wave in the range of 15% to 20% earlier than said first timing whereby a misfiring nozzle may be detected.

28. (Canceled)

29. (New) A print head apparatus, comprising:

a substrate;

an ink expulsion mechanism provided on said substrate;

an ink well defined proximate said ink expulsion mechanism and a nozzle formed as an egress from said ink well; and

at least two pressure sensors that are formed substantially at said ink well and configured to detect pressure waves induced by a firing of said ink expulsion mechanism.

30. (New) The print head apparatus of claim 29, wherein the at least two pressure sensors cooperatively detect the pressure waves.

31. (New) The print head apparatus of claim 29, wherein the at least two pressure sensors redundantly detect the pressure waves.

32. (New) The apparatus of claim 29, wherein the at least two pressure sensors include at least one sensor selected from the group consisting of a piezoelectric acoustic wave transducer and an interdigitated pressure wave transducer

33. (New) The apparatus of claim 10, wherein said pressure wave of said first non-zero magnitude occurs at a first time delay, and wherein said sensor mechanism is capable of detecting a pressure wave that occurs at a second time delay different from said first time delay that is indicative of when said nozzle is unclogged.